agricultural research

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agricultural research

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Helping Others to Help Us—And Themselves

IN 1954, the 83rd Congress passed a law, P.L. 480, which has influenced the economies of half the earth. Called the Food for Peace Act, the law initially provided for sending food aid to foreign countries in exchange for their currencies. Some of these currencies could not be spent outside the country of origin and were, therefore, termed "soft."

A part of these "soft" currencies has since been used under the amended law for foreign research grants. USDA was the first U.S. Department to take advantage of the research provisions of Public Law 480.

ARS uses these foreign currencies to support agricultural, forestry, and economic research of mutual benefit to American farmers and consumers and to the participating countries.

Through its International Programs Division, Hyattsville, Md., and regional offices in Rome, Italy, and New Delhi, India, ARS represents all USDA agencies participating in this activity.

Since 1958, 1,700 research projects have been negotiated in 32 countries on 5 continents. These grants complement, but do not duplicate our domestic research.

Within this structure USDA has been the architect of a grand design, indeed—by developing new export markets and new industrial uses for American farm products.

The research program, with its unique feature of assigning an ARS-cooperating scientist for each grant, has studied exotic pests and diseases, thus providing solutions to problems that could become a threat to U.S. agriculture.

In Spain, for example, researchers found that African swine fever, potentially the most devastating of all hog diseases is transmitted by a species of tick.

The genetic diversity of world crop germplasm—some of which is in great danger of being lost—has been revitalized through P.L. 480 research.

Other high priorities—biological controls of insect and weed pests, protection for stored crops, soil and water conservation, agricultural engineering, human and animal nutrition—all have been touched and furthered by ARS-sponsored foreign research.

Thus committed, we have come full circle in the realization that we must help the farmers of developing nations to improve their agriculture if we are to transform those nations into better cash customers for our own farm products.—*M.C.G.*

Editor: H. G. Hass

Assistant Editor: R. W. Deimel

Contributors to this issue:

R. J. Bjork, V. R. Bourdette, F. W. Brouard, R. H. Fones, M. C. Guilford, P. L. Goodin, E. Likums, M. A. Meliker, S. C. Miller, M. E. Nicholas, R. G. Pierce, L. C. Yarris

COVER: Dairy cattle eat rations mixed according to data obtained at the ARS Energy Metabolism Unit at Beltsville, Md. Utilizing fully automated metabolism chambers linked to a centralized computer system, scientists at the unit can determine how well various feeds meet the energy requirements of dairy cattle (0677W777–1). Article begins on page 8.

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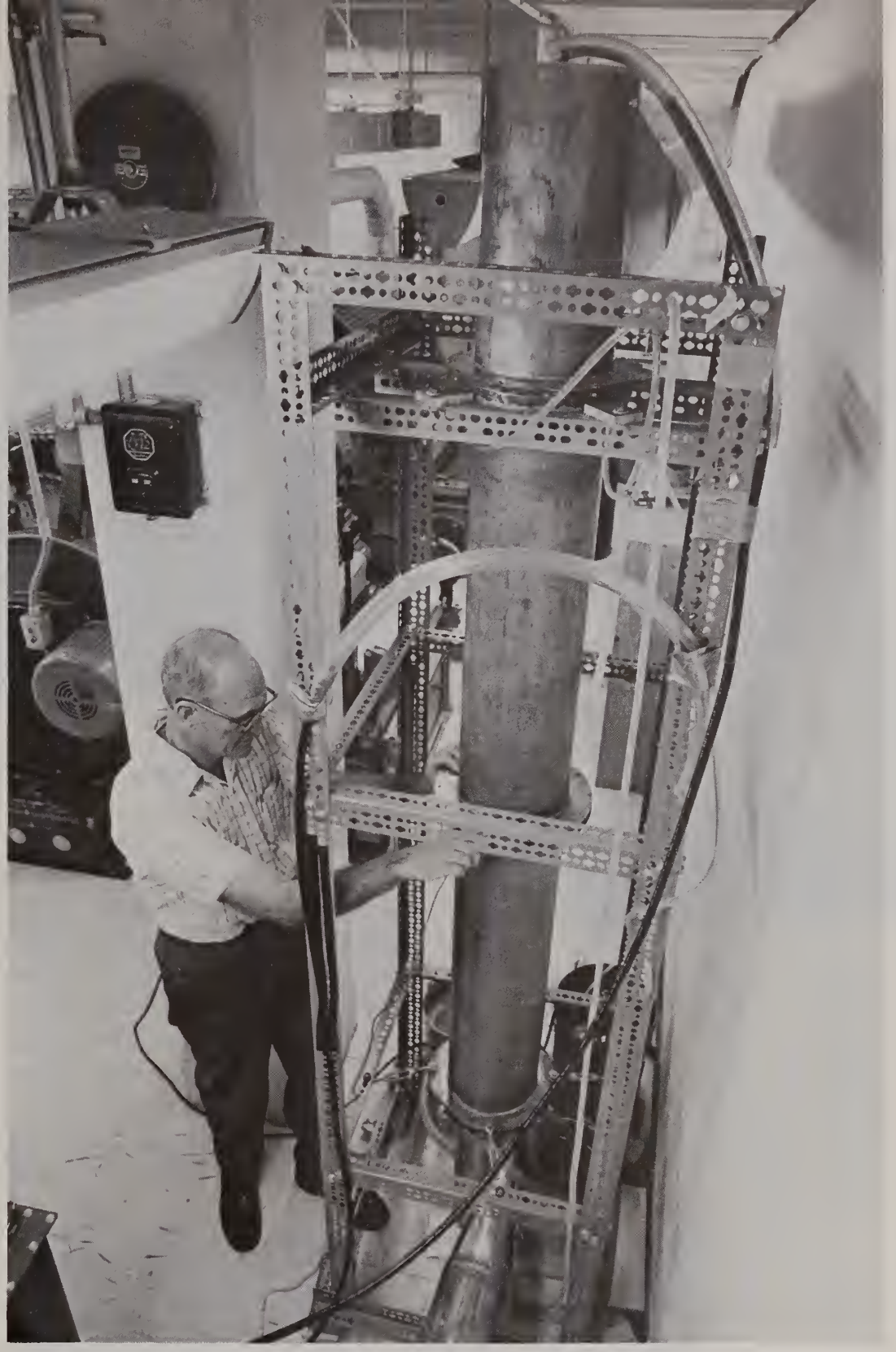
Bob Bergland, Secretary
U.S. Department of Agriculture

Talcott W. Edminster, Administrator
Agricultural Research Service



Mr. Copeland attaches a ground wire to the experimental wet-wall electro-inertial air cleaner to complete the electrical circuit and ensure that dust particles will be properly attracted to the surface of the tube where they will be washed away by the water bath (0677X735–27).

Model Air Cleaner for Cotton Mills

AN EXPERIMENTAL wet-wall air cleaner that employs both electrostatic and inertial forces has been developed to control and remove dust generated during cotton fiber processing in gins and textile mills.

The combination of electrostatic and inertial forces offers high efficiency collection of fine, respirable dust, and the wet wall is used to continuously flush out the trapped dust and avoid the problems of dust re-entrainment and fire.

Need for a highly efficient and economical air cleaner is essential to control respirable cotton dust believed to cause byssionsis, a lung disease that affects some persons working in cotton

Dr. Thibodeaux adjusts the filtering device used to sample and measure the amount of particulate matter entering the experimental air cleaner (0677X736–36).

***Above:** Water swirls down the inner surface of the tube, washing away electrically charged dust particles. The charging wire, too fine to be seen, is suspended in the center of the tube (0677X736–14). **Below:** This filter disk, designed to trap particles as small as 0.6 micrometer, reveals the high concentration of respirable particulate matter in the air of a textile mill carding room (0677X736–24).*

textile mills.

The cleaner was designed by R. R. Reif of Battelle Memorial Institute, Columbus, Ohio, under centract with ARS. Working closely with Mr. Reif were physicists Devron P. Thibodeaux and Albert Baril, Jr., of the Southern Regional Research Center (P.O. Box 19687, New Orleans, LA 70179).

The air cleaner design consists of a vertical tube equipped with a coaxial charging wire and a tangential air entrance to impart cyclonic motion to the dust-laden air. The interior wall of the tube is bathed continuously with a thin film of water.

Dust entering the tube is charged by corona from the electrically charged coaxial wire and is attracted to the tube wall by both the electrical and centrifugal forces. The film of water washes the collected dust down the tube wall to a discharge sump.

Major considerations in designing the air cleaner included high operating efficiency, low maintenance, low operating costs, and simplicity of design.

Results obtained with 4-inch and 8-inch diameter tubes indicate that the design is sound and may be scaled up for a wide range of air capacities. The largest capacity tested with the 8-inch tube was 875 cubic feet per minute, barely sufficient air for use with a single processing machine such as a card. A system for a typical textile mill would require 30,000 to 60,000 cubic feet of air per minute.—*V.R.B.*

A Walking Insect Trap

A SYNTHETIC pyrethroid, resmethrin, applied on clothing to protect against blood-feeding insects may replace repellent-treated clothing. Resmethrin does not repel or prevent biting insects from coming to their human hosts. It does, however, induce intoxication, knockdown and death.

Its potential as a clothing impregnant to protect people from mosquitoes and other blood-feeding insects was established by entomologists Carl E. Schreck and Donald E. Weidhaas and research technicians Nelson Smith and Kenneth H. Posey at the Insects Affecting Man Research Laboratory (P.O. Box 14565, Gainesville, FL 32604).

"While repellents are effective, their ability to prevent bites and annoyance declines over time," says Mr. Schreck. "Increasing numbers of blood-feeding ticks, mosquitoes and stable flies tend to congregate around the host and finally begin to bite. Too, repellents generally have little or no effect on the number of such insects in the areas. They simply provide temporary protection from annoyance and bites."

Resmethrin was chosen as a test material because it appeared to have little, if any, repellency. Because repellents merely keep insects at bay, the scientists were looking instead for an insecticide like resmethrin which kills on contact. Resmethrin was also readily available and safe. It was impregnated into lightweight net jackets or yard goods by the absorption of acetone solutions at a rate of 0.0625 grams of resmethrin to 1 gram of netting.

Female mosquitoes were placed in the response chamber of an olfactometer, a machine that uses odors to attract or repel insects. The mosquitoes were exposed to an airstream coming from a round opening so that they entered the opening and its trap, passing through treated or untreated netting and making contact with one or the other.

Mosquitoes that passed through the treated netting showed over 90 percent mortality in 4 hours, and most mosquitoes that touched the netting were knocked down or showed symptoms of exposure within ten minutes. Therefore, resmethrin did not alter approach to a host. The vapor was not toxic to people or mosquitoes. Had the vapor been toxic to the mosquitoes, it would have precluded their landing on the jackets, which would have made it impossible to test for a contact insecticide.

In field tests at South New Smyrna Beach, the scientists were primarily interested in measuring any reduction in the number of biting mosquitoes after they made contact with people wearing pyrethroid-treated jackets. A determination consisted of counting the total mosquitoes that landed on the clothed upper halves of the bodies of each pair of standing subjects within 20 seconds. Then, after putting on resmethrin-treated jackets, the four subjects returned to the test area for 1 hour.

The reduction in the number of mosquitoes biting immediately after the 1-hour exposure—91 percent—and then 1 hour later—73 percent—was considered high.

"The only 'treatment' of the approximately 1.4 acres was 4 people wearing treated net jackets and walking through the area," said Dr. Weidhaas. "The protection provided by the jackets combined with the reduction in number of mosquitoes was highly significant."

In outdoor cage tests involving rabbits covered with a treated net, the number of female mosquitos present on the third day was approximately 40 to 50 percent lower. Only 1 percent of the *An. quadrimaculatus* and 4 percent of the *Ae. aegypti* survived to the seventh day when treated netting was used, while 22 and 71 percent of the mosquitoes, respectively, survived in the untreated units.

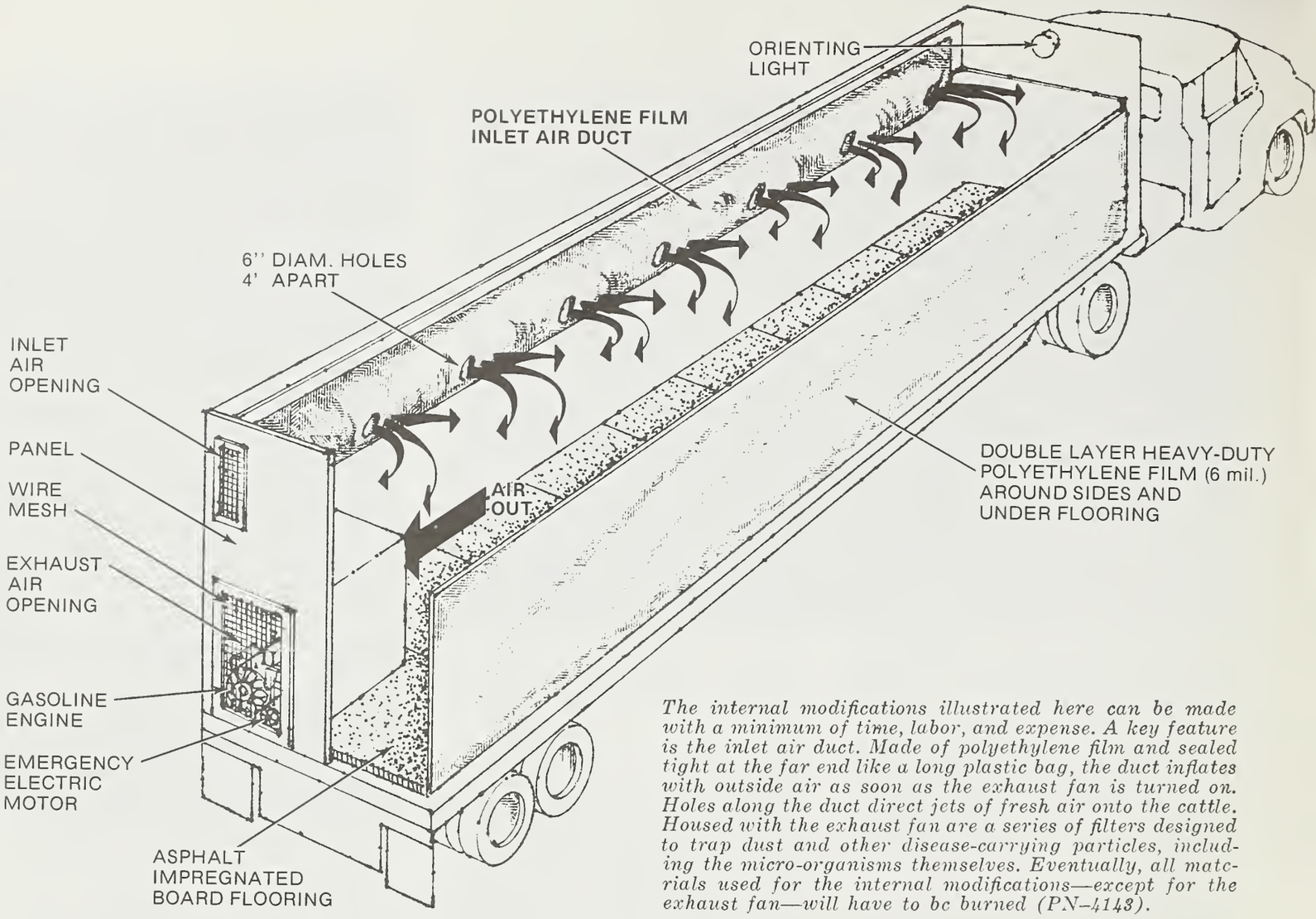
A similar test was conducted with stable flies in another outdoor cage, using 2 male Holstein calves as hosts. In the treated side containing a calf wearing treated netting, the count was reduced by 92 percent in 32 hours, and after 32 hours, only 35 live stable flies were counted.

In other tests, treated jackets also protected researchers from the bites of deer flies.

"The original premise that toxicants such as synthetic pyrethroids might be replacements for clothing repellents seems valid," said Mr. Schreck. In the case of deer flies, sand flies, ticks, mites, and black flies that land and crawl before biting the protection may be almost complete, but further tests are needed to confirm this idea. With mosquitoes, some biting may occur but the attacking insects do not survive.

"It would be interesting to study the effect of biting arthropods on a group of about 60 people moving into an area of high mosquito density. The toxic effect of the clothing might reduce annoyance and biting as well as disease. Even animals might be trained to wear treated covers or would receive topical skin applications," said Mr. Schreck.

The method should be tested against many of the world's major disease vectors in both laboratory and field studies, say the scientists. Some of the new synthetic pyrethroids may turn out to be the ideal protectant against these tiny Draculas.—*P.L.G.*



The internal modifications illustrated here can be made with a minimum of time, labor, and expense. A key feature is the inlet air duct. Made of polyethylene film and sealed tight at the far end like a long plastic bag, the duct inflates with outside air as soon as the exhaust fan is turned on. Holes along the duct direct jets of fresh air onto the cattle. Housed with the exhaust fan are a series of filters designed to trap dust and other disease-carrying particles, including the micro-organisms themselves. Eventually, all materials used for the internal modifications—except for the exhaust fan—will have to be burned (PN–4143).

Transporting Disease-Exposed Cattle

Right: *Animals exposed to major communicable diseases can be quickly loaded into this modified trailer and transported to meat packing plants without risking any spread of the disease along the way. Revised plans for the quarantine van have the exhaust fan at the bottom, as indicated in the drawing (0975X806–4).*

SOME PREVIOUSLY accepted practices in the control of animal diseases are being reconsidered in light of the high losses that can occur with heavy concentrations of cattle in feed lots. At present, all cattle that have been exposed to a major communicable disease are slaughtered and withheld from marketing channels even though the animals may never have contracted the disease.

An Animal Protein Conservation Work Group formed by USDA–Animal and Plant Health Inspection Service concluded that an alternative to existing disease control methods would be to inspect all the exposed animals and remove those free of clinical illness.

The healthy animals could then be consigned to a meat packing plant for special processing.

Mr. Paul E. James, agricultural engineer, Beltsville Agricultural Research Center (Bldg 200, BARC–EAST, Beltsville, MD 20705), has designed a mode of transportation that would safely move disease-exposed cattle. Mr. James modified a 40–foot enclosed trailer to contain any potential disease while used for hauling cattle.

The modified trailer has a seal to prevent leakage of solid and liquid wastes. A ventilating system contains a special unit for filtering contaminated air. The system also permits adequate ventilation to remove excess moisture, animal heat, ammonia, and carbon dioxide.

Extensive tests were conducted to determine if the trailer performed satisfactorily. Temperatures were measured throughout the trailer while it was loaded with cattle during hot weather. Repeated observations were also made while the loaded trailer was in transit. The unit was designed to transport 19,000 pounds of cattle for a 2–hour trip. The modified trailer easily met all the demands.—*M.A.M.*

Below: *ARS engineer Paul James checks readout from a multiple-source data-gathering device, here programmed as a multiple-point temperature monitor. Temperatures inside all parts of the truck, as well as around the cattle, are recorded every five minutes. Inside-outside temperature comparisons are crucial to an evaluation of the trailer's ventilation system (0975X804–26).*

Plant Causes Super Sunburn

SINCE 1913 a disease of unknown cause has afflicted cattle from 30 countries that stretch along the Texas Gulf coast from the Rio Grande to the Sabine river.

Photosensitization—excessive sensitivity to sunlight—has been reported on as many as 5,000 cattle in a single county in a single year. The disease is a major problem of the cattle industry and causes serious economic losses from weight loss, blindness, and mastitis. Other complications include secondary infections and screwworm infestations in the lesions caused by photosensitization. Also, calves are orphaned when the cows' teat and udders become sore and they will not allow the calves to nurse.

The culprit has been found.

Although it is still looking for other causes, a research team headed by veterinary medical officer J. W. Dollahite of the Veterinary Toxicology and Entomology Research Laboratory (P.O. Drawer GE, College Station, TX 77840), and including personnel from the Texas Agricultural Extension Service have shown that a plant, *Ammi majus* or bishops weed, causes the disease in the United States.

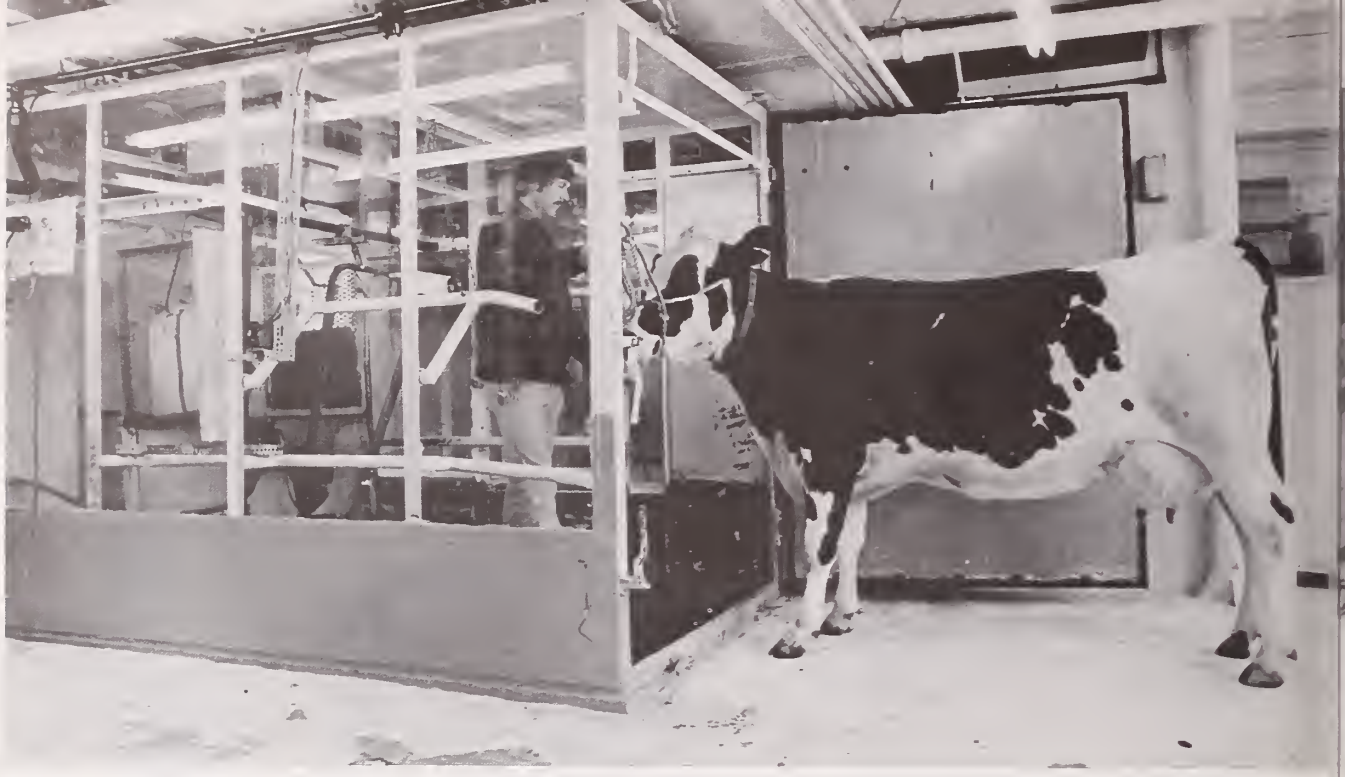
Two Israeli scientists recently reported producing the disease symptoms of photosensitization in cattle and geese by feeding them *Ammi majus*, a member of the family Umelliferae. Since the plant grows on the U.S. Gulf coast, it was immediately suspected of causing the disease in local livestock.

The plant is not native to the U.S. but was introduced from the old world. It is probably responsible for photosensitization in coastal regions other than those studies by Dollahite's team.

The researchers collected the plant and fed it to cattle and sheep in measured amounts under controlled conditions. After exposure to sunlight, all the animals developed symptoms of the disease as did the seven employees who handled the plant. Both animals and men recovered from the disease, although new sores sometimes appeared on previously unexposed skin areas. This was found to occur up to 30 days following initial contact with the plant.

The disease is like a super bad sunburn. On the animals, it first produced redness, then blistering, loss of skin, and sores on muzzle, ears, udders, and other body parts. Dark as well as light colored animals are affected. The symptoms in themselves have not been known to be fatal except when followed by secondary complications such as screwworm infestations.

Because the symptoms develop from contact with the plant as well as from feeding on it the scientists believe that a few plants per acre could cause the disease. Animals might rub against the plant while feeding on other plants and thereby develop lesions of the face and eyes, or they might develop lesions of the udders while bedding on it.—*B.D.C.*



Cows remain in the respiration chamber for 2 weeks. The first week is usually a "period of adjustment" for the cows during which no tests are made. During the second week, all excreta is collected for 7 days and respiration exchange is measured for 3 days (PN–4134).

Computers -- New Aid to Dairyn

LIKE MANY BUSINESSES, dairy farming has gone to computers. Not only are computers used to select the sires of next year's calves, they are also used to develop feeding rations.

In the past, dairymen fed their cows "by guess and by golly," They dumped feed in the bunk, and the cows ate what they wanted. Some cows got a bit chubby, and others wasted feed. But feed was relatively cheap and as long as the cows were milking, the farmers were content.

Today, things are different. Computers are used to determine the best ration at the least cost to the farmers. Some cows are even fed rations individually computed for them based on their milk production.

One laboratory in this country is largely responsible for providing the data that farmers need to feed their cows correctly. The Energy Metabolism Unit at the Beltsville Agricultural Research Center. Beltsville, Md., is the largest laboratory of its type in this country and one of the largest in the world. Its purpose is to determine how much energy various feed stuffs supply and what an individual cow requires in terms of feed energy.

Energy values of feed and energy requirements of dairy cattle are determined in the laboratory by enclosing a cow in a large steel and plexiglass chamber. Once in the chamber, exact measurements are made of the types of feed the cow eats and how the cow uses the feed. To measure feed utilization, all the bodily functions of the cow are measured; how much weight she gains or loses, how much air she breathes, how much methane gas (a product of digestion) she burps, how much milk she produces, how much heat she gives off, and how much urine and feces she excretes.

Highly complex instruments hooked into the chamber measure such factors as gas production, air consumption, and body temperature. All these data, along with measurements for milk production and feed consumption are fed into a computer and recorded on printouts. Before computerization, it took the scientists 6 months to record the data and make the calculations they now do in 1 week. Cows in the chambers (there are six chambers in all) are monitored continually over a 2-week period. The first week is devoted to setting up norms for each individual cow; the actual experiments and calculations are made the second week.

One finding of the laboratory has been of special significance to dairymen. The scientists have concluded that it takes the same amount of energy to produce a quart of milk whether the cow gives 2,000 or 20,000 quarts of milk a year. Her energy requirements per unit of milk, when expressed in

Above: A major end-product of feed fermenting in the rumen is acetate. To test how well this cow utilizes acetate, research technician Roy L. Brocht places "eggbeater" tubing—here used for the infusion of metabolites—into its rumen. The eggbeater twists of the tubing keep the metabolites away from the walls of the rumen. The cannula, or lined porthole on the side of the cow, is a common sight in many laboratories conducting this kind of research. There are five cannulated cows at the Energy Metabolism laboratory (0676X655–3A).

Above: Biological laboratory technician Thomas B. Jacobs, Jr. washes a sample of feed with neutral detergent, leaving only the cell walls intact. Cell walls make up the fiber in feeds, and fiber content determines the potential intake and digestibility of a feed. The cell wall test—a now widely used procedure developed by ARS in the early 1960's—enables scientists to more meaningfully characterize the availability of energy in feeds. In addition, this procedure is increasingly being used for measuring fiber content in foods intended for human consumption (0676X658–14).

ıen at Feeding Time

terms of energy actually absorbed from the digestive tract, do not vary with the amount of milk she gives. This is contrary to the once popular belief that the more milk a cow produced, the more energy it took per quart to produce it.

The data recorded by the laboratory since its beginning in 1958 have revolutionized the feeding of dairy cattle. A new concept, called the net energy (NE) value of feeds, developed by scientists at the laboratory is fast replacing the old concept of total digestible nutrients or TDN.

TDN has been the traditional method of measuring the value of a feed. TDN represents the actual amount of feed that is digested and made available to the cow's body. NE, on the other hand, represents the amount of the digested nutrients that a cow actually uses for meat and milk production. ARS animal scientist Dr. Paul Moe (Building 162, Beltsville Agricultural Research Center-East, Beltsville, MD 20705), who heads up the laboratory, says two feeds may have equal values for TDN, but different net energies. In other words, farmers using the old TDN system might have thought two feeds had the same energy value for milk production when they actually did not.

Using the chambers, the scientists can determine not only the energy values of feeds, but how feed additives influence metabolism, how volatile fatty acids in

***Right:** Dr. Moe checks readout from the Lab's centralized computer system that collects data on the heat production inside each respiration chamber. Such heat measurements are necessary to determine the total energy balance between an animal's intake (feed) and output (excretion). There are several metabolism chambers around the world with auxilliary computer-analysis capabilities, but the Energy Metabolism Lab at Beltsville is the only one with all of its respiration measurements fully automated and processed through a centralized computer facility (0677W775–2).*

Computers - - Aid to Dairymen

Above: Getting it all together: The highly technical data obtained by the Energy Metabolism Unit must somehow reach the dairy farmer. The data itself is generally published in scientific journals subscribed to by USDA Extension Service offices throughout the United States. Here, representatives from a major feed corporation and a large dairy farm in Maryland meet with Walter Bay (center) of the Extension Service to develop feeding programs based on published findings from the Energy Metabolism Unit. Conferences like this play an increasingly important role in America's dairy industry. To the left are Bob Reed and Herbert Wessel (far left) from Fairmont Dairy Farms. To the right are John Harner (standing) and Jesse Smith from Agway Corporation (0677W776–7). ***Right:*** *From the conference to the farm: Dairy operations throughout the country can benefit from the data supplied by the Energy Metabolism Unit at Beltsville, Md. Whether the farms are large or small—with or without automated feeding systems—the optimum feed-energy balances for the dairy cattle are the same (0677W780–17A).*

a cow's rumen shift according to what she eats, and how a rumen stimulant works.

Much of the data collected by Dr. Moe and his colleague, Dr. Henry Tyrrell, have been used to correct old, inaccurate data. Says Dr. Moe, "We have found large discrepancies in previously published data on feed values. This is not surprising, since our method of determining feed values is so much more accurate than older methods. Technology has advanced rapidly since energy values were first assigned to feeds."

Dr. Tyrrell has conducted studies with cattle fed either forage or grain diets. He has found that cattle make better use of acetic acid, an end product of digestion, and gain weight more efficiently when acetic acid is part of a grain diet. Dr. Tyrrell wants to determine why this happens. The answer might enable cattlemen to supplement forage diets so that cattle would gain as well on forage as they do on grain diets.

The majority of the work of Dr. Moe and Dr. Tyrrell, however, is still with dairy cattle and it is this work that has made the laboratory world-famous.

"The number of dairy farms in this country is constantly shrinking," says Dr. Moe, "but the milk production of individual cows continues to rise. As we breed higher producing cows, their diets become more critical because the energy demands on their bodies increase. Efficient feeding of dairy cattle is really what our laboratory is all about."—*M.E.N.*

Above: Biological aid Linda Moy prepares a "bomb calorimeter" for measuring the energy inside a small sample of feed. The "bomb" is a highly pressurized (up to 20 atmospheres of O_2) container in which the sample is burned. The temperature increase that results in a surrounding body of water reveals how much energy was inside the sample. This technique is used to measure energy in feed, feces, milk, and urine (0676X657–21A).

Growth Retardants Studied for Elm, Sycamore

INJECTION OF GROWTH retardants in elm and sycamore trees reduced regrowth by 9 feet over a 3–year period in experiments at the Nursery Crops Research Laboratory, Delaware, Ohio.

Agricultural Research Service tests showed that injecting trees with growth retardants after initial pruning can reduce pruning requirements, avoid spray drift damage to nearby plants, and save chemicals.

Galen K. Brown, agricultural engineer, says tree regrowth under power lines, along roads and railroads, as well as around homes and buildings, is a continuing problem. Mechanical pruning is costly as is foliar spraying with growth-regulating chemicals. Spray drift sometimes causes problems by damaging nearby plants and by wasting material.

Dr. Brown, formerly research leader of the Delaware laboratory, now research leader at East Lansing, Mich., says the first test injections of American elm were made in 1973 by plant pathologist Charles L. Wilson and research technician Donald E. Wuertz. Dr. Brown is with the Fruit and Vegetable Harvesting Research Laboratory (Rm. 207, Dept of Agricultural Engineering, Michigan State Univ., East Lansing, MI 48823).

"The preliminary results from the tests suggested that pressure-injected growth regulators could reduce regrowth of both the length and number of shoots," Dr. Brown says.

In 1974 Dr. Brown, working with Dr. Wilson, Mr. Wuertz, biometrician William P. Kwolek, plant pathologist Gene A. Jumper, and chemist Susan G. Carr, tested seven growth retardants on 135 American elms in the Delaware nursery. The trees were 4 to 7 inches in diameter at a point 4½ feet above ground level.

All trees were topped in April to stimulate sprouting from the limb stubs. During the first 2 weeks in June, each of seven chemicals was pressure-injected into 15 trees. In all treatments, 400 ml of material was injected into three holes drilled 3 inches deep into the trunk about 3 feet above ground level. Sprout growth within 10 inches of the end of each limb stub was recorded.

Growth from the treated trees was noticeably less than that of the control trees. The two most effective materials, daminozide and maleic hydrazide, were selected for continued testing.

Both American elm and American sycamore were used in the 1975 and 1976 tests. Maleic hydrazide, at a rate of 2.2 grams per liter, and daminozide, at a rate of 48 grams per liter, were both effective treatments in reducing sprout length as well as in reducing the average number of sprouts. No abnormal shoot or leaf development was observed at these treatment levels.

"The results continue to show that sprout regrowth can be reduced significantly by trunk injection, and growth reduction can be achieved without adverse foliar effects if appropriate dosages are used. If minor foliar damage does occur the first year, it disappears the following year so a long-term detrimental effect appears unlikely," Dr. Brown says.

Although trends of the research indicate that, 3 years after treatment, growth of sprouts on treated trees is at least 1 year behind growth of sprouts on untreated trees, additional research must be done before the potential reduction in sprout length and savings in pruning cost can be accurately shown.

The researchers speculate that more uniform results might be obtained if several elements were used to determine dosage, such as tree canopy size, number of limbs, and soil conditions rather than just tree trunk size, which was the only factor used in determining dosage for these tests.

Improved injection equipment being developed in the course of the project, such as that discussed in "Inoculating the Dutch Elms" on page 14, may simplify treatment techniques and equipment, making small scale treatment practical for home owners.

The growth retardant project at Delaware, now directed by plant physiologist Bruce R. Roberts, is funded in part under a cooperative agreement with the Electric Power Research Institute, Palo Alto, Calif.—*R.G.P.*

Chilly Chicks Can't Cope

CHILLED CHICKENS don't always shiver their way through the processing plant. They're arrested en route by an Inter-State official, an on-site federal meat inspector.

The charge: airsacculitis, a disease of the respiratory tract produced by mycoplasma-bacteria, which peaks in winter months.

Back in the '50s when flock condemnations were sometimes up to 20 or 30 percent, much of the blame was put on wide and long houses or too many birds per pen, too large flocks, or inexperienced growers. Since 1970 scientists have suspected that condemnations due to *mycoplasma gallisepticum* (MG) and *mycoplasma synoviae* (MS) are related to low temperatures and also, but less so, to humidity.

Veterinarian Harry W. Yoder, heading a multi-disciplinary team of researchers including agricultural engineer Liston N. Drury and microbiologist Stuart R. Hopkins at the USDA Southeast Poultry Research Laboratory (934 College Station Road, Athens, GA 30605), have the first

The cotton swab inserted down this broiler's windpipe will help confirm the existenee of a respiratory infection. Microplasma organisms picked up by the swab are allowed to grow and multiply in a laboratory medium. Such proof of infeetion is integral to the scientific validity of these experiments (0277X163–14).

***Left:** Dr. Yoder utilizes "multiparameter environmental cabinets" to scientifically verify commonly believed relationships between cold air and certain respiratory diseases of poultry. These cabinets can be controlled for air temperature, humidity, and ventilation. Designed by agricultural engineers in ARS, the cabinets have served a long array of poultry research projects requiring carefully controlled environments (0277X162–17A).*

documented proof of the low temperature hypothesis.

Blood samples and air sac exudates were obtained at processing plants when 18 flocks of broilers originating from Arkansas, North Carolina, and Georgia had unusually high airsacculitis condemnations. MS was more frequently involved than MG.

After this finding, experiments were conducted to determine the influence of ventilation rate, air temperature, relative humidity, and the route of inoculation of MS cultures on the incidence and severity of airsacculitis.

For these studies, White Rock chickens of both sexes came from flocks free of mycoplasma, Newcastle disease, infectious bronchitis, avian encephalomylitis, and Marek's disease. Parents and progeny were hatched and reared in high-efficiency, filtered-air positive-pressure (FAPP) units. Inoculated chicks 3 to 4 weeks old were maintained in small metal isolation cabinets, under negative pressure, within a disease isolation building.

In preliminary studies, Newcastle disease virus (NDV) strain B_1, and infectious bronchitis virus (IBV) Massachusetts type were used as a drinking water vaccine given for 1 day and 5 days prior to MS exposure by various routes.

Studies were terminated 21 days after MS exposure. Cultures were taken from each trachea and most of the affected air sacs. A blood sample was collected, the birds were weighed, and the sex of each chicken was determined. A lesion score representing the severity and extent of airsacculitis observed in each chicken was recorded.

Airsacculitis was not produced by MS only, nor with the vaccine only. However, airsacculitis was produced in 20 to 30 percent of the chickens given MS after the NDV–IBV vaccine. Unexpectedly, there was more airsacculitis among chickens housed in cabinets with higher ventilation rates than with low ventilation rates. Relative humidity was not controlled in these cabinets operated at room temperature.

A final group of experiments was conducted in 5 larger multiparameter environmental cabinets containing 30 chickens each. Chicks were exposed to infectious bronchitis virus by contact with inoculated chicks, and MS was administered by aerosol 5 days later.

High (31° to 32° C), medium (19° to 24° C), and low (7° to 10° C) air temperatures were used along with high (75 to 90 percent), medium (38 to 56 percent) and low (23 to 26 percent) relative humidities. A moderate ventilation rate was constant in all cabinets.

Airsacculitis was most extensive at low temperatures, 45 percent as compared to only 5 to 12 percent at high temperatures.

Relative humidity was generally of less influence, said Dr. Yoder, although the trend was toward more airsacculitis at lower relative humidity within medium temperature ranges.

"Our findings would seem to confirm that increased condemnations during winter months are closely related to reduced temperatures in poultry houses, if mycoplasma infection is present," Dr. Yoder said.

"Certainly the findings emphasize the care needed in describing the relative pathogenicity of MS isolates when no attention is given to the temperature at which experimental chickens are housed."—*P.L.G.*

Inoculating the Dutch Elms

A SIMPLIFIED INJECTION SYSTEM utilizing water-soluble fungicides has shown promising results in preliminary research aimed at controlling Dutch elm disease.

"Only field tests will tell us how effective the technique and material will be, but early results have been encouraging," plant pathologist Charles L. Wilson says.

Dr. Wilson, with USDA's Agricultural Research Service, at the Ohio Agricultural Research and Development Center, (Wooster, OH 44691) is trying to find new, more effective chemicals for control of Dutch elm disease (DED) and a less costly means of applying them.

"The basic problem has been the lack of a material that can be applied in a small volume. Because of poor solubility or toxic effects of high concentrations, fungicides now in use require large volumes, up to 20 gallons per tree. This requires drilling holes 3/8-inches in diameter at 6-inch intervals around each tree," Dr. Wilson said.

"This method also requires heavy and expensive equipment as well as trained people to operate it. The cost limits the number of trees that can be treated and discourages many homeowners and communities from treating their elm trees," he said.

The DED problem has been complicated by what appears to be increased resistance of DED to the commonly used control chemical, benomyl, and also by the appearance of more aggressive forms of the DED organism, *Ceratocystis ulmi.*

Working with plant pathologist Robert A. Spotts and research aid Charles R. Semer of OARDC, Dr. Wilson screened the fungicidal activity of five chemicals against DED. Three of the materials, captan, benomyl, and MBC, were known to be active against DED. The other two, fenarimol and XE–326s, were experimental compounds of unknown activity. Because XE–326s showed good water solubility and high fungicidal activity in laboratory tests, Dr. Wilson selected it for field injection.

Dr. Wilson worked with ARS researchers at the Nursery Crops Research Laboratory (P.O. Box 365, Delaware, OH 43015), who are developing a simple injection method for small volumes.

Twelve trees in the Delaware plots (every other three in a row of 24) received 4 grams (0.14 ounce) of active material. The trees were 4 to 6 inches in diameter and the injections were made 4½ feet above the ground. Four holes were drilled 2 inches deep at right angles into each tree with a 3/32-inch drill bit. Five milliliters (1/8 fluid ounce) of solution containing 2 percent actual active XE–326s was injected in each hole May 13, 1976, with a pistol-grip syringe with 50-milliliter capacity and a 12-guage needle.

On June 14, all 24 trees were inoculated with an aggressive isolate of DED by placing two drops of the spore suspension in two chisel wounds, one on each side of the tree. Inoculation stresses the tree much more than would natural infections.

The trees were examined on July 9 and August 13. At the first examination, the treated trees averaged 16 percent damage in the tree crown. The 12 untreated trees averaged 80 percent crown damage. Thirty-five days later the treated trees showed 44 percent crown damage, while the untreated trees averaged 88 percent crown damage.

"These preliminary results indicate that XE–326s shows some promise for control of DED," Dr. Wilson said. "However, considerable research remains to be done. We do not know what effect XE–326s has on natural infections of DED or what curative qualities, if any, it might have. Our tests, so far, have shown no toxic effects from XE–326s, but elm tolerance should be studied."

Tiny holes (3/32-inch diameter) are drilled into elms as the first step in this experimental method to simplify the control of Dutch Elm Disease. Instead of heavy equipment, small drills—electrically rechargeable or hand-powered—can be used. The depth of the hole depends on the diameter of the tree trunk (PN–4140).

"We will treat 20 elms in the city of Wooster this year and check the elms in the area regularly to see if the treatment helps the trees resist DED under natural conditions," he said.

"The battle against DED is not won. But we are clearly making progress. In 1975, ARS researchers at Delaware, Ohio, released the first hybrid elm developed in this country that has resistance to DED (AGR. RES., May 1976, p. 9 and Sept. 1965, p. 3). The development of more soluable systemic fungicides, which move effectively throughout the tree, along with the development of easier and cheaper injection methods increases prospects that we might actually 'cure' trees infected by DED," Dr. Wilson said.—*R.G.P.*

The method being tested by Dr. Wilson requires chemical compounds that are effective in small volumes. The key is high water solubility: it means less water is needed to inject the chemical into the tree, and it promotes the spread of the chemical throughout the tree. The rubber gloves and plastic apron are standard protective measures in experiments of this kind, especially when they involve a variety of chemicals with unknown toxicity (PN–4141).

A veterinarian's syringe is used to inject the chemical into the hole. Up to 70 pounds pressure may be required for a sufficient dose. This type of injection apparatus would have to be available to the consumer if the chemicals being tested prove safe, effective, and marketable. The total time for treating a tree is about 10 minutes, as opposed to an average of over 1 hour per tree with chemicals and procedures in current use (PN–4142).

AGRISEARCH NOTES

Blueberries—new industry?

ARS RESEARCH in Mississippi has pointed the way to a potential new small fruit industry in the Gulf Coastal states. After 6 years of exploratory research, Dr. J. M. Spiers and the staff at the Agricultural Research Station (P.O. Box 287, Poplarville, MS 39470), are convinced that the production of rabbiteye blueberries will provide a new source of cash income to rural residents with small acreages in Mississippi and elsewhere in the South.

'Tifblue', 'Woodward', 'Climax', and other rabbiteye blueberries may yield as many as 14 pints from each plant in the sixth year of growth. These varieties are relatively disease and insect free and require little cultivation. They grow well in acid soils.

Growers planting 600 plants per acre may at peak production earn nearly $7,500 in income from about a 5-acre pick-your-own operation, where a grower will allow purchasers to pick the berries at a reduced price.—E.L.

Mycorhizae to the rescue

IMAGINE TREES growing on former strip mine sites where nothing has grown for years, or landscape and field crops growing with half the amounts of fertilizer normally required. Such possibilities exist because of a naturally occurring fungi that increase the rooting of woody plant cuttings.

The fungi, called mycorhizae (see AGR. RES., Dec. 1976, p. 16) live in a symbiotic state in plant roots. In tests conducted on cuttings of bearberry and huckleberry, two popular native landscape plants that are difficult to propagate using normal rooting procedures, more cuttings developed more roots when the rooting medium was inoculated with mycorhizae.

The increased number of roots increases the plant's nutrient uptake and enables it to become established in soils during the stressful period following transplant. It is also believed that the mycorhizae produce many other growth benefits in plants well beyond the rooting stage.

Exactly how the mycorhizae increase rooting is not known. ARS plant pathologist, Robert G. Linderman, Ornamental Plants Research Laboratory (3420 Southwest Orchard Street, Corvallis, OR 97330), who is conducting the study, suspects that the fungi are producing substances that create a chemical change in the cutting or the rooting environment. This change induces the plant to produce more roots than it normally would.

Future research will focus on understanding the biology behind the rooting enhancement and on determining whether the mycorhizae rooting phenomenon also occurs in other plants. The ultimate goal is to use these beneficial fungi for practical application in horticulture.—*L.C.Y.*

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Straightening crooked calves

A PROGRAM THAT requires that cows between the 40th and 70th days of pregnancy be prevented from grazing either young lupines or lupine in the mature seed stage can all but eliminate crooked calf disease.

Crooked calf disease is a serious economic problem for ranchers in the 11 western States. An average of 2 percent of all calves born each year where lupine is a problem suffer from the disease. Last year nearly 10,000 calves were born damaged.

The disease is characterized by twisted or bowed limbs or spine, twisted neck, cleft palate or a combination of any of these deformities. It occurs when mothers eat certain species of lupine during the critical period of pregnancy.

ARS chemist Richard F. Keeler and ARS animal scientist Lynn F. James, with cooperation from Utah State University veterinarians James L. Shupe and Kent R. Van Kampen, all at Logan, Utah, Poisonous Plant Research Laboratory (1150 E. 14th N., Logan UT 84322), have identified the chemical compound in lupine that produces the deformities.

In studying the compound, which is the alkaloid anagyrine, the researchers learned that whether or not a calf suffers damage depends on how much anagyrine the mother consumes and when she consumes it.

By controlling when pregnant cows graze lupine, the cases of crooked calf disease can be minimized. Other practices to further help the situation include regulating cattle breeding periods and reducing the abundance of lupine on the range.

Many ranchers have tried mineral supplementation to reduce incidences of crooked calf disease. The ARS study found no evidence to support this practice.—*L.C.Y.*

Assessing soil fertility

A NEW METHOD of measuring and assessing a soil's fertilizer needs by simulating the rate of flow of phosphorus and potassium ions through the soil and into plant roots has been devised.

Results from the new method compare favorably with traditional chemical tests for soil fertility without the usual risk of undue chemical alteration of the soil. It is expected that by using the new method, four to five soils could be *completely* analyzed daily. Current chemical tests provide only partial analysis of a soil and several separate tests must be run to obtain a complete analysis.

It is now generally accepted by agronomists that the diffusive rate (rather than solution flow) at which nutrient ions such as phosphorus and potassium move to a plant's root zone determines a plant's uptake of these nutrients which, in turn, determines the plant's prosperity.

The rate of diffusion of these nutrient ions depends on soil fertility. By measuring this rate, ARS researchers have developed a simple method to characterize the soil's fertility.

The measuring is done with two soil-resin cells that faithfully simulate chemical conditions in the root zone of a given soil. An untreated soil is used in one cell while in the other cell the same soil fertilized only with phosphorus and potassium is used. After the nutrients in the soil are partially depleted by the resin they are extracted from the resin and measured.

The developers of this new method to assess soil fertility were ARS soil scientist Truman W. Massee, Snake River Conservation Research Center (Route 1, Box 186, Kimberly, ID 83341), and chemist R. A. Olsen and soil scientist E. O. Skogley, Montana State University, Bozeman, Mont.—*L.C.Y.*

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